The 2014 Oil Price Collapse and the Diverse Tales of Three Oil Exporters

Samya Beidas-Ström and Marco Lorusso

ICD Seminar

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Central questions

- What has been the impact of the 2014 oil price collapse on oil exporters' key macro variables?
- Are oil exporters' economic structures and policy instruments/toolkits similar? If not, how different are they, and why is this distinction important?
- Given these differences, what is the best approach to fiscal consolidation in oil exporting economies?
- Does the global shift away from fossil fuels bode ill for oil exporters? Or can they support growth in their economies while oil is cheap? If they do, are their side effects?
- How can policy makers in these oil exporting economies better calibrate or target fiscal and other reforms to support medium-term output growth, without building up vulnerabilities?

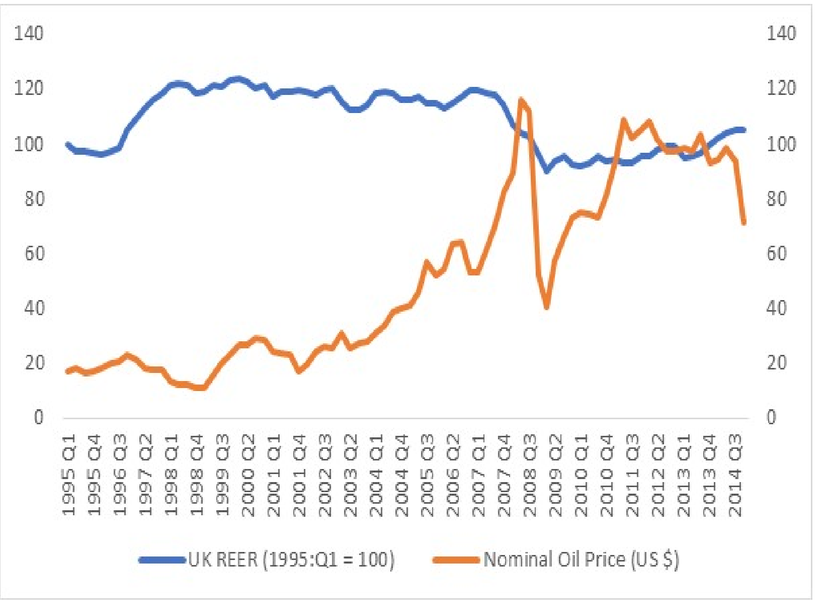
Outline of Presentation

- Stylized facts from three oil exports: Russia, Saudi Arabia and the U.K.
- Modelling these oil exporter
- Estimation of our models—different underlying structures and rich policies
- Responses from fiscal and oil intensity shocks
- Drivers of output volatility in 2014
- Scenarios for better outcomes
- Conclusions and policy implications

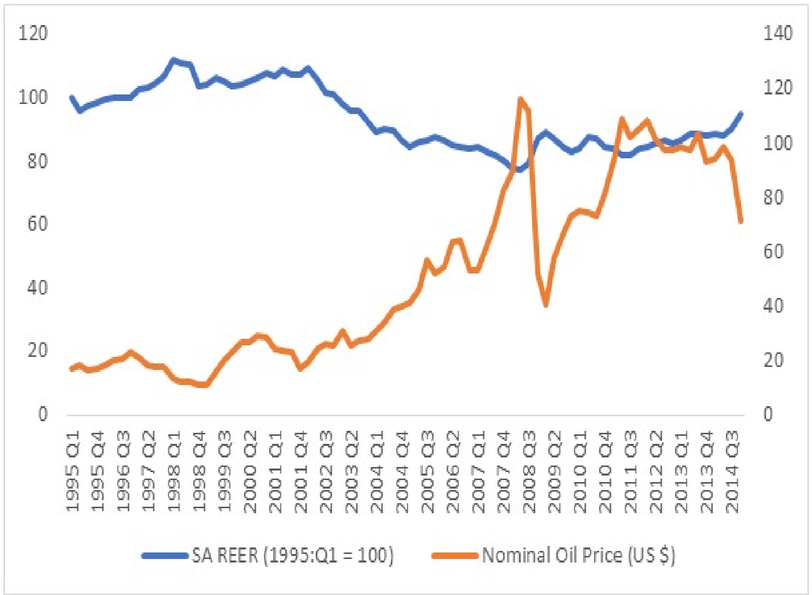
DATA AND STYLIZED FACTS

Oil prices and TOT co-move reflecting exchange rate regime and extent of diversification

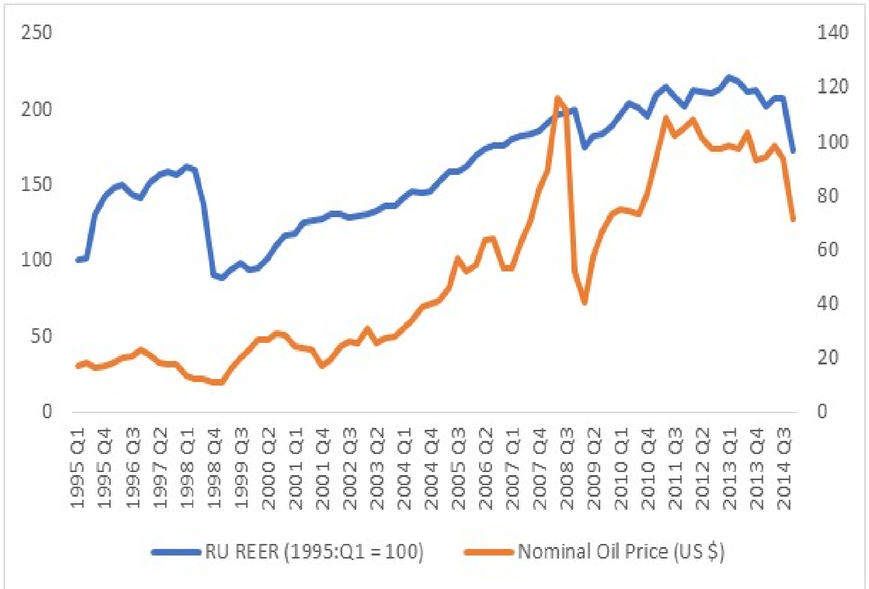
UK



Saudi

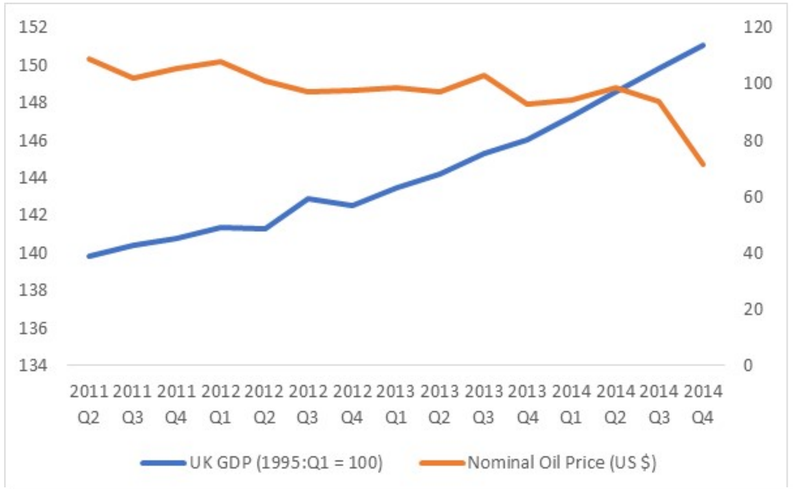


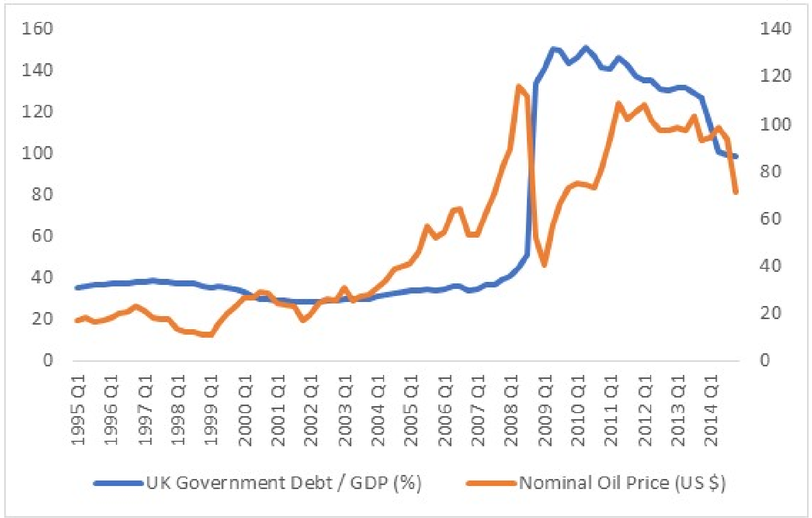
Russia



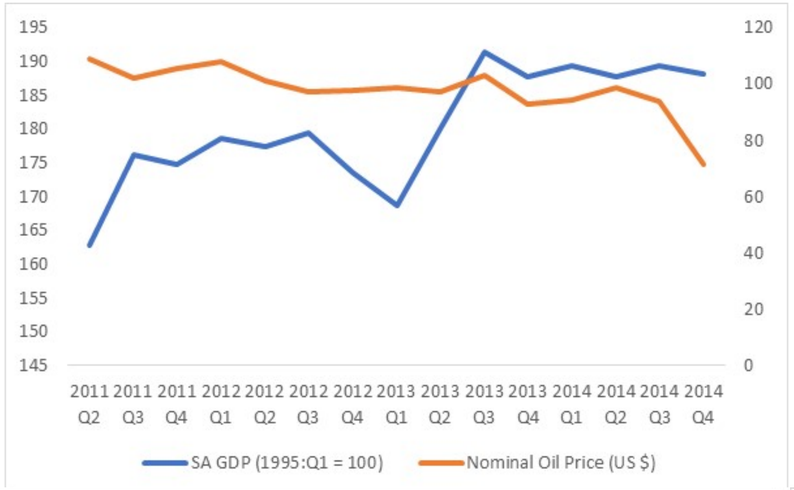
Output, public debt and oil prices

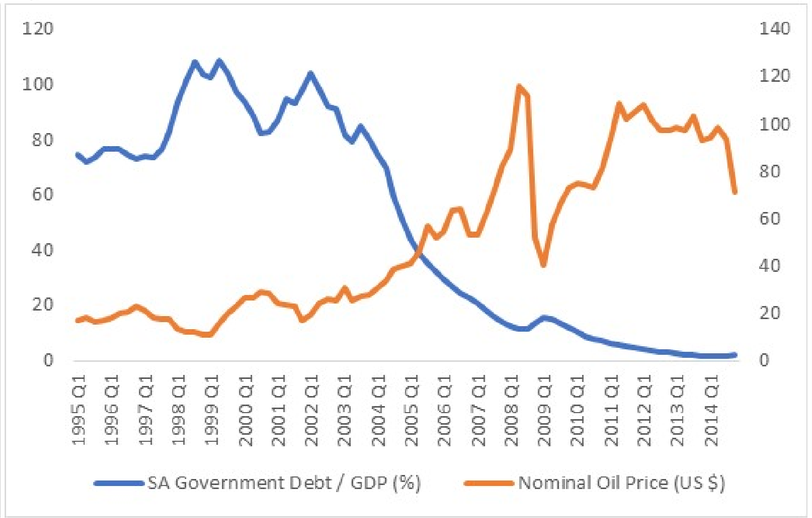
UK



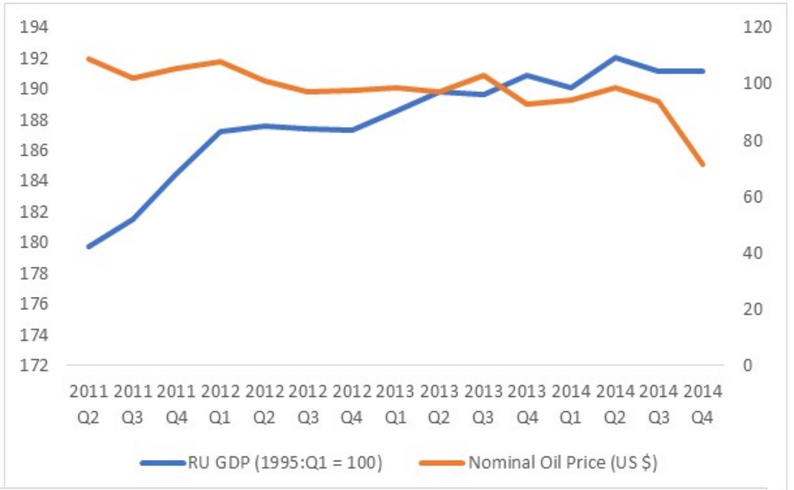


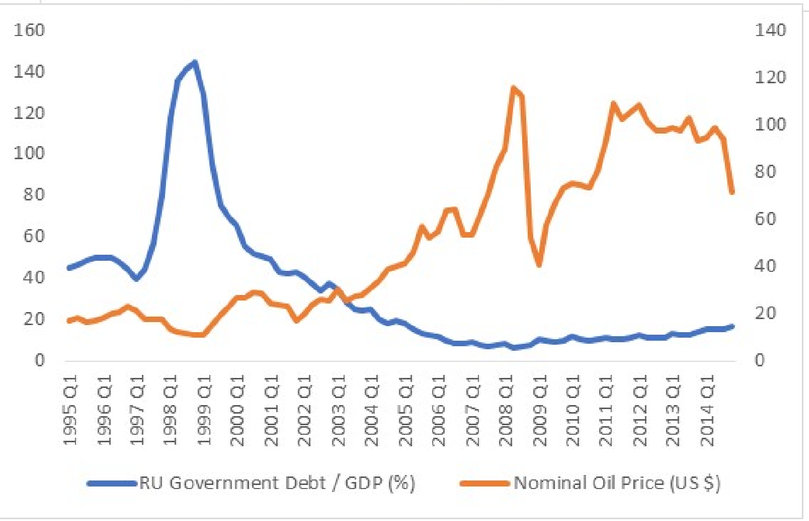
Saudi





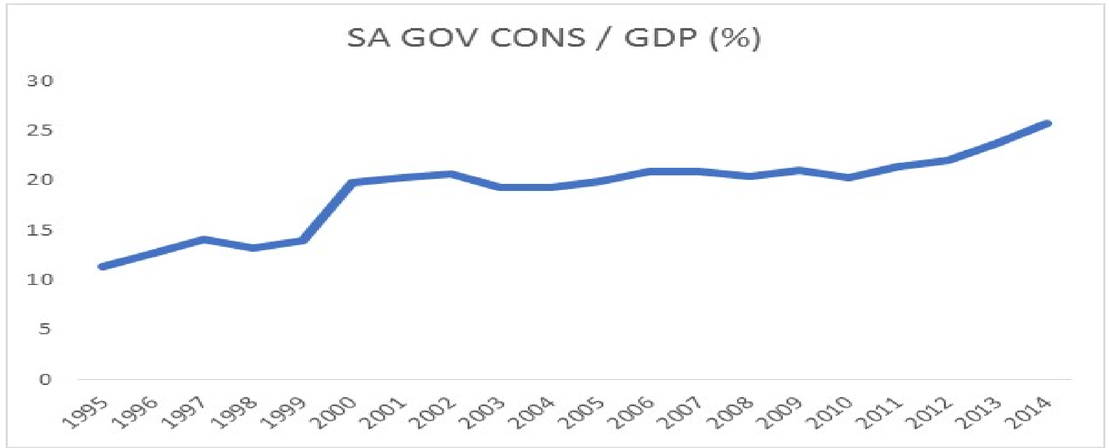
Russia

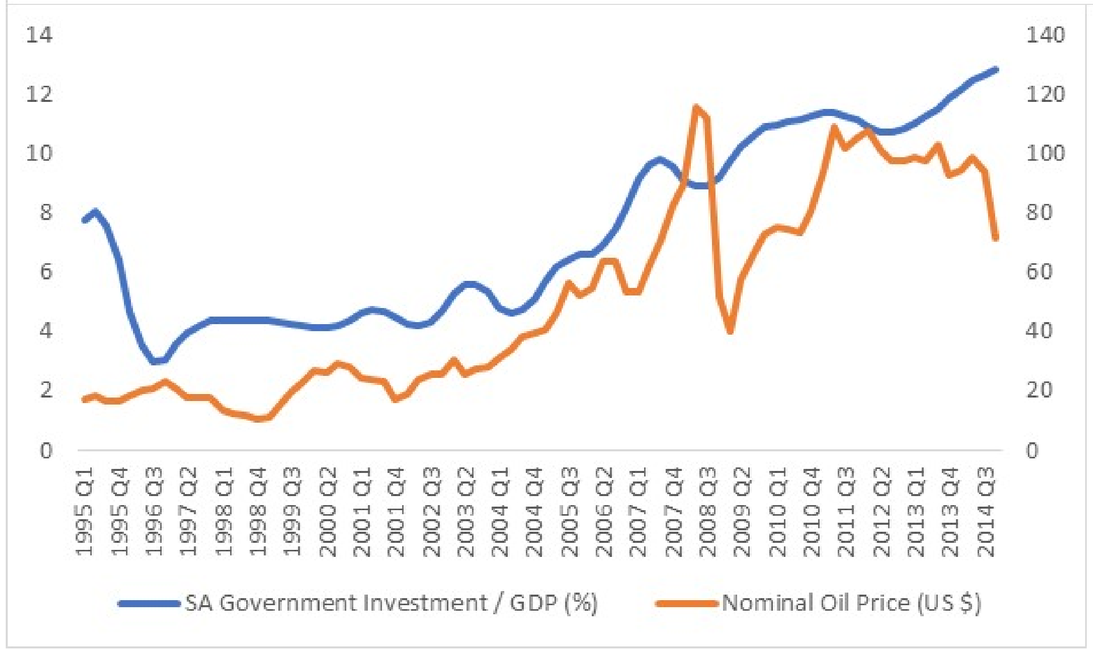




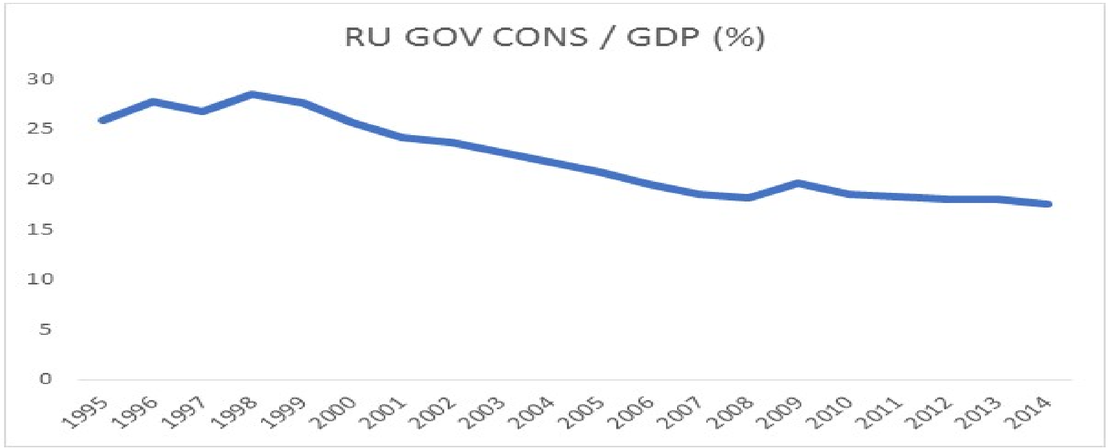
Public spending and oil prices

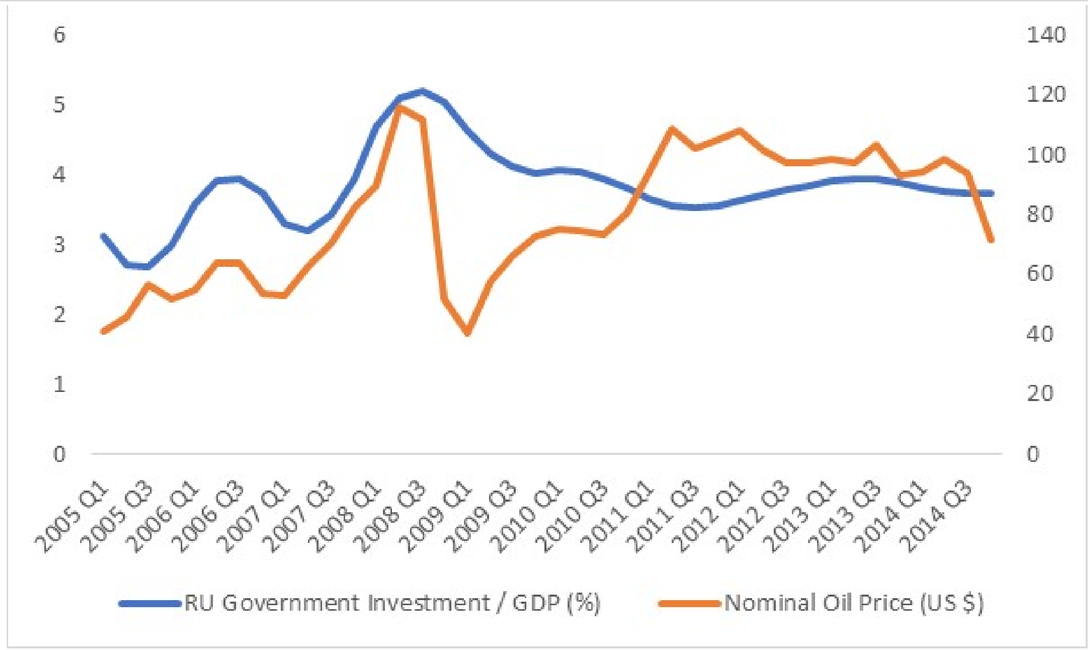
Saudi





Russia





MODEL OVERVIEW

Households' maximization problem

Max utility

$$E_t\left\{\sum_{j=0}^{\infty}\beta_1^j\left[\begin{array}{c}\frac{1}{1-\sigma_1}\left(Z_{1,t}^c C_{1,t+j}-\kappa_1 C_{1,t+j-1}\right)^{1-\sigma_1}+\\ \frac{1}{1-\chi_1}\left(1-L_{1,t+j}\right)^{1-\chi_1}\end{array}\right]\right\}$$

s.t. budget constraint

UK

$$\begin{aligned}&\left(1+\tau_{1,t}^c\right)P_{1,t}^c C_{1,t}+P_{1,t}^i I_{1,t}+\left(R_{1,t}^b\right)^{-1}B_{1,t+1}+\frac{e_{1,t}\left(R_{2,t}^b\right)^{-1}B_{1,t+1}^f}{\phi_{1,t}^b}\\ =\;&\left(1-\tau_{1,t}^l-\tau_{1,t}^{wh}\right)W_{1,t}L_{1,t}+R_{1,t}^k K_{1,t-1}+\left(1-\tau_{1,t}^d\right)D_{1,t}\\ &+\left(1-\tau_{1,t}^{yo}\right)P_{1,t}^o Y_{1,t}^o+B_{1,t}+e_{1,t}B_{1,t}^f\end{aligned}$$

Saudi

$$\begin{aligned}&\left(1+\tau_{1,t}^c\right)P_{1,t}^c C_{1,t}+P_{1,t}^i I_{1,t}+\left(R_{1,t}^b\right)^{-1}B_{1,t+1}+\frac{e_{1,t}\left(R_{2,t}^b\right)^{-1}B_{1,t+1}^f}{\phi_{1,t}^b}\\ =\;&\left(1-\tau_{1,t}^{wh}\right)W_{1,t}L_{1,t}+R_{1,t}^k K_{1,t-1}+\left(1-\tau_{1,t}^d\right)D_{1,t}\\ &+\left(1-\tau_{1,t}^{yo}\right)P_{1,t}^o Y_{1,t}^o+B_{1,t}+e_{1,t}B_{1,t}^f\end{aligned}$$

Russia

$$\begin{aligned}&\left(1+\tau_{1,t}^c\right)P_{1,t}^c C_{1,t}+P_{1,t}^i I_{1,t}+\left(R_{1,t}^b\right)^{-1}B_{1,t+1}+\frac{e_{1,t}\left(R_{2,t}^b\right)^{-1}B_{1,t+1}^f}{\phi_{1,t}^b}\\ =\;&\left(1-\tau_{1,t}^l\right)W_{1,t}L_{1,t}+R_{1,t}^k K_{1,t-1}+\left(1-\tau_{1,t}^d\right)D_{1,t}\\ &+\left(1-\tau_{1,t}^{yo}\right)P_{1,t}^o Y_{1,t}^o+B_{1,t}+e_{1,t}B_{1,t}^f\end{aligned}$$

and private capital accumulation

$$K_{1,t}=\left(1-\delta_1\right)K_{1,t-1}+\left(1-S\left(\frac{I_{1,t}}{I_{1,t-1}}\right)^2\right)Z_{1,t}^i I_{1,t}$$

Firms' minimization problem

Produce three types of goods, two of which use **oil**:

(i) Demand side: Final private consumption goods sold to hhs, produced competitively:

$$C_{1,t} = \left((\omega_1^{cc})^{\frac{\rho_1^o}{1+\rho_1^o}} \left(C_{1,t}^{ne}\right)^{\frac{1}{1+\rho_1^o}} + (\omega_1^{oc})^{\frac{\rho_1^o}{1+\rho_1^o}} \left(Z_{1,t}^{o} O_{1,t}^{c}\right)^{\frac{1}{1+\rho_1^o}} \right)^{1+\rho_1^o}$$

After combining domestic consumption goods with imported foreign goods:

$$C_{1,t}^{ne} = \left((\omega_1^{c})^{\frac{\rho_1^c}{1+\rho_1^c}} \left(C_{1,t}^{d}\right)^{\frac{1}{1+\rho_1^c}} + (\omega_1^{mc})^{\frac{\rho_1^c}{1+\rho_1^c}} \left(Z_{1,t}^{m} M_{1,t}^{c}\right)^{\frac{1}{1+\rho_1^c}} \right)^{1+\rho_1^c}$$

(ii) Private investment goods, produced competitively, with imported foreign goods:

$$I_{1,t} = \left((\omega_1^{i})^{\frac{\rho_1^c}{1+\rho_1^c}} \left(I_{1,t}^{d}\right)^{\frac{1}{1+\rho_1^c}} + (\omega_1^{mi})^{\frac{\rho_1^c}{1+\rho_1^c}} \left(Z_{1,t}^{m} M_{1,t}^{i}\right)^{\frac{1}{1+\rho_1^c}} \right)^{1+\rho_1^c}$$

Firms (concluded) and Output

Produce three types of goods, two of which use **oil**:

(iii) Supply side: Intermediate domestic goods produced **monopolistically**:

UK

$$V_{1,t}(i) = \left((\omega_1^k)^{\frac{\rho_1^v}{1+\rho_1^v}} (K_{1,t-1})^{\frac{1}{1+\rho_1^v}} + (\omega_1^l)^{\frac{\rho_1^v}{1+\rho_1^v}} (Z_{1,t}L_{1,t})^{\frac{1}{1+\rho_1^v}} \right)^{1+\rho_1^v}$$

With public capital playing a key role in recent years (unlike UK)

Russia & Saudi Arabia

$$V_{1,t}(i) = \left((\omega_1^k)^{\frac{\rho_1^v}{1+\rho_1^v}} (K_{1,t-1})^{\frac{1}{1+\rho_1^v}} + (\omega_1^{kg})^{\frac{\rho_1^v}{1+\rho_1^v}} (K_{1,t-1}^g)^{\frac{1}{1+\rho_1^v}} + (\omega_1^l)^{\frac{\rho_1^v}{1+\rho_1^v}} (Z_{1,t}L_{1,t})^{\frac{1}{1+\rho_1^v}} \right)^{1+\rho_1^v}$$

Being s.t. time-to-build delays

$$K_{1,t}^g = (1-\delta_1^g) K_{1,t-1}^g + A_{1,t}^g \qquad I_{1,t}^{gd} = 1 - \phi^{gi} A_{1,t-1}^g$$

And thus **total output production**

$$Y_{1,t} = \left((\omega_1^{vy})^{\frac{\rho_1^o}{1+\rho_1^o}} (V_{1,t})^{\frac{1}{1+\rho_1^o}} + (\omega_1^{oy})^{\frac{\rho_1^o}{1+\rho_1^o}} (Z_{1,t}^o O_{1,t}^y)^{\frac{1}{1+\rho_1^o}} \right)^{1+\rho_1^o}$$

Fiscal and monetary sectors

Different **fiscal regimes** as manifest in these budget constraints:

UK

$$P^g_{1,t}G^d_{1,t} + B_{1,t} = \tau^c_{1,t}P^c_{1,t}C_{1,t} + \left(\tau^l_{1,t} + \tau^{wh}_{1,t} + \tau^{wf}_{1,t}\right)W_{1,t}L_{1,t} + \tau^d_{1,t}D_{1,t} + \tau^{oc}_{1,t}P^o_{1,t}O^c_{1,t} + \tau^{yo}_{1,t}P^o_{1,t}Y^o_{1,t} + \left(R^b_{1,t}\right)^{-1}B_{1,t+1}$$

Saudi

$$P^g_{1,t}G^d_{1,t} + P^{kg}_{1,t}I^{gd}_{1,t} + B_{1,t} = \tau^c_{1,t}P^c_{1,t}C_{1,t} + \left(\tau^{wh}_{1,t} + \tau^{wf}_{1,t}\right)W_{1,t}L_{1,t} + \tau^d_{1,t}D_{1,t} + \tau^{yo}_{1,t}P^o_{1,t}Y^o_{1,t} + \left(R^b_{1,t}\right)^{-1}B_{1,t+1}$$

Russia

$$P^g_{1,t}G^d_{1,t} + P^{kg}_{1,t}I^{gd}_{1,t} + B_{1,t} = \tau^c_{1,t}P^c_{1,t}C_{1,t} + \left(\tau^l_{1,t} + \tau^{wf}_{1,t}\right)W_{1,t}L_{1,t} + \tau^d_{1,t}D_{1,t} + \tau^{yo}_{1,t}P^o_{1,t}Y^o_{1,t} + \left(R^b_{1,t}\right)^{-1}B_{1,t+1}$$

where tax elasticities are estimated

Different **monetary regimes** as manifest in these Taylor rules:

UK

$$i_{1,t} = \bar{i}_1 + \gamma^i_1\left(i_{1,t-1} - \bar{i}_1\right) + \left(1-\gamma^i_1\right)\left[\left(\pi^{core}_{1,t} - \bar{\pi}^{core}_1\right) + \gamma^\pi_1\left(\pi^{core}_{1,t} - \bar{\pi}^{core}_1 - \bar{\pi}^{core}_{1,t}\right) + \gamma^y_1 y^{gap}_{1,t}\right]$$

where:

$$i_{1,t} = R^b_{1,t} - 1$$

Saudi & Russia

$$i_{1,t} = \bar{i}_1 + \gamma^i_1\left(i_{1,t-1} - \bar{i}_1\right) + \left(1-\gamma^i_1\right)\begin{bmatrix}\left(\pi^{core}_{1,t} - \bar{\pi}^{core}_1\right) + \\ \gamma^\pi_1\left(\pi^{core}_{1,t} - \bar{\pi}^{core}_1 - \bar{\pi}^{core}_{1,t}\right) + \\ \gamma^y_1 y^{gap}_{1,t} + \gamma^e_1\left(rer_{1,t} - rer_{1,t-1}\right)\end{bmatrix}$$

where:

$$i_{1,t} = R^b_{1,t} - 1$$

Full set of fiscal tax rules

$$\hat{\tau}^{c}_{1,t} = \psi^{cc}_{1}\,\hat{c}_{1,t}$$

$$\hat{\tau}^{l}_{1,t} = \psi^{ly}_{1}\,\hat{y}^{d}_{1,t} + \psi^{lb}_{1}\,\hat{b}_{1,t-4}$$

$$\hat{\tau}^{wh}_{1,t} = \psi^{wb}_{1}\,\hat{b}_{1,t-4}$$

$$\hat{\tau}^{oc}_{1,t} = \psi^{ococ}_{1}\,\hat{o}^{c}_{1,t}$$

$$\hat{\tau}^{wf}_{1,t} = \psi^{wb}_{1}\,\hat{b}_{1,t-4}$$

$$\hat{\tau}^{d}_{1,t} = \psi^{dd}_{1}\,\hat{d}_{1,t}$$

$$\hat{\tau}^{yo}_{1,t} = \psi^{yopo}_{1}\left[\frac{\hat{P}^{o}}{\hat{P}^{GDP}}\right]_{1,t}$$

ESTIMATION—DEEP PARAMETERS

Not all oil exporters are alike structurally

Underlying structural features of oil economies—not all are alike:

- Although Russia and Saudi Arabia have big public spending ratios similar to UK, due to big role of the state in economy and welfare state, investment spending is smaller and:
- Saudi Arabian HHs prefer to supply less labor
- Both HHs face higher borrowing costs
- Both are more capital intensive:
  - Capital especially large in goods production
  - And in imported capital Saudi goods production
- Both more oil intense in consumption and production, with latter particularly large—both open up room for more adequate taxation
- Russia's consumption is less heavily weighted in imports—unlike the UK and Saudi
- Public capital in both faces time-to-build delays and depreciates less than private capital
- Wages and prices are more rigid or indexed in Russia and Saudi than in the UK, holding back potential output

Estimated structural parameters

	δ_1^g	Φ_1^{gi}	L_1^{SS}	ϕ_1^b	ϕ_1^k	ϕ_1^{kg}	ω_1^{oy}	ω_1^{oc}	ω_1^{mc}	ω_1^{mi}	$\frac{(G_1^d)^{SS}}{(Y_1^d)^{SS}}$	$\frac{(I_1^d)^{SS}}{(Y_1^d)^{SS}}$
UK	--	--	33	0.01	25	--	3	2	34	40	20	--
Russia	1.5	50	40	0.05	31	5	25	8	18	21	22	4
Saudi Arabia	1.5	50	25	0.02	35	4	31	9	31	55	19	7

	κ_1	ξ_1^w	ξ_1^p	ι_1^w	ι_1^p
UK	92	32	72	32	45
Russia	50	65	62	22	90
Saudi Arabia	75	80	59	28	74

With different policy toolkits and elasticities

Policy toolkit differs—not all oil exporters are alike:

Policy levers

- Unlike the UK which taxes oil and labor more than other sectors, and whose monetary policy favors fighting inflation and interest rate volatility
- Saudi firms and HHs least taxed, whose monetary policy favors targeting the level of the exchange rate (peg)
- While Russia is an intermediate case

Tax elasticities

- UK makes full use of highly elastic VAT, with Saudi less so, opening room for further effort
- Russia makes full use of highly elastic CIT, with Saudi almost none, opening room for further effort
- Neither Russia nor Saudi have taxed fuel used in consumption or production, opening room for further effort

	$(\tau_1^c)^{SS}$	$(\tau_1^l)^{SS}$	$(\tau_1^{wh})^{SS}$	$(\tau_1^{oc})^{SS}$	$(\tau_1^{wf})^{SS}$	$(\tau_1^d)^{SS}$	$(\tau_1^{yo})^{SS}$	γ_1^π	γ_1^y	γ_1^i	γ_1^e
UK	10	19	12	44	12	15	35	45	13	93	--
Russia	15	13	--	--	30	58	50	37	23	88	83
Saudi Arabia	4	--	10	--	--	1	71	19	29	20	108

Elasticities	VAT	Labor Income to GDP	Labor Income to public debt	Social security to public debt	Fuel taxes to oil demand	CIT to firm profitability	Taxes on natural resource sector
UK	124	99	58	8	89	41	15
Russia	71	101	91	88	--	99	158
Saudi Arabia	95	--	--	80	--	90	111

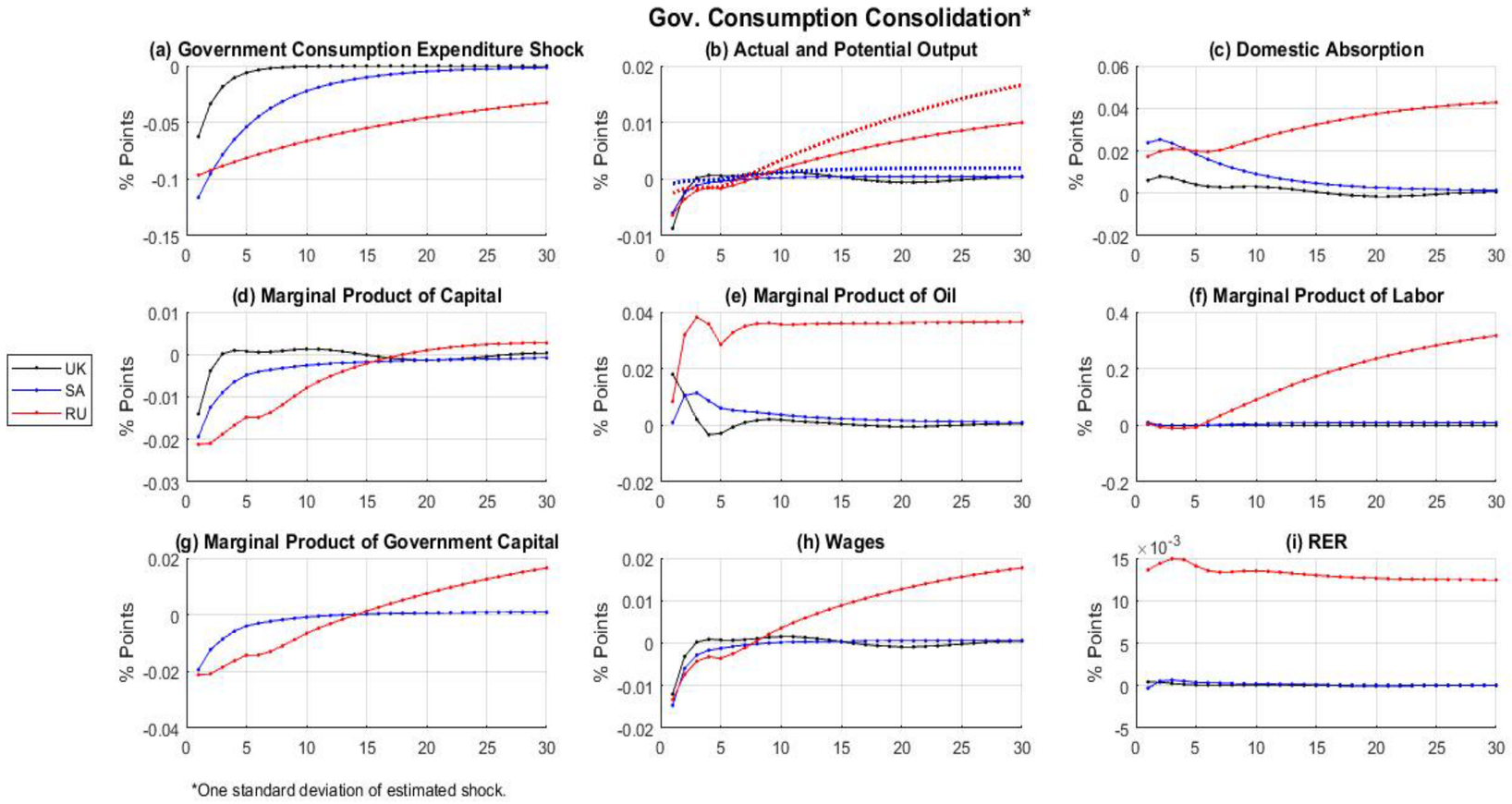
ESTIMATION—RESPONSES TO SHOCKS

Durable gains from reducing current spending

Does it hurt?

Temporary pain for large and durable gains later

- Reducing size of Russian C^g fruitful as estimated shock large and most persistent, – $\Delta Debt^{gov}$
- While output response to – ΔC^g hurts for 7 quarters, it's a temporary pain
- As from the supply: the response of MP of all factors positive, esp. $+\Delta MP^L$, and competitiveness
- Reinforced from the demand side: HHs receive +Δ wealth effect, $-\Delta L^s$ and $+\Delta C^p$

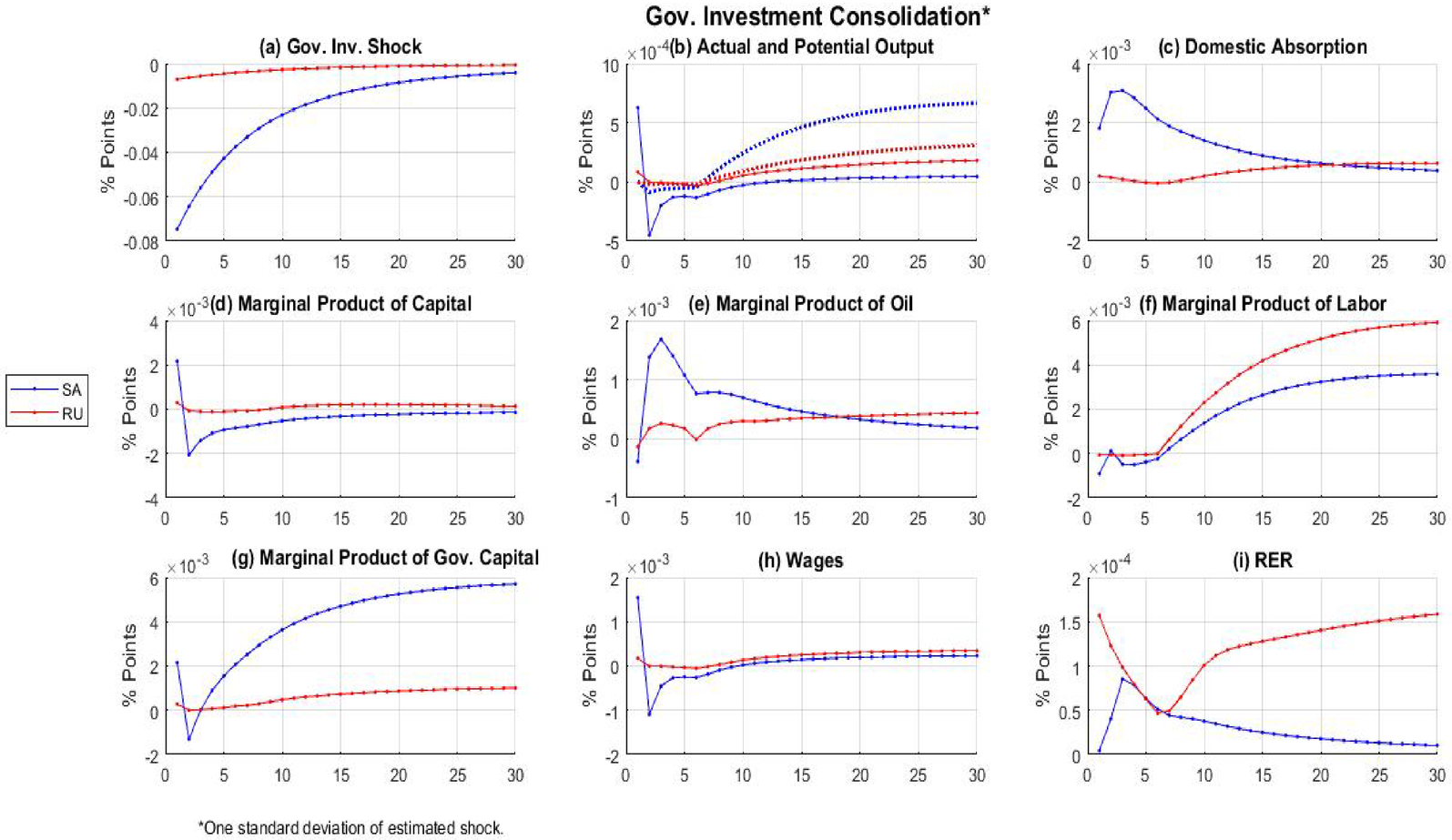


Smaller gains from capital spending cuts

Does it hurt?

Less, with durable but smaller gains

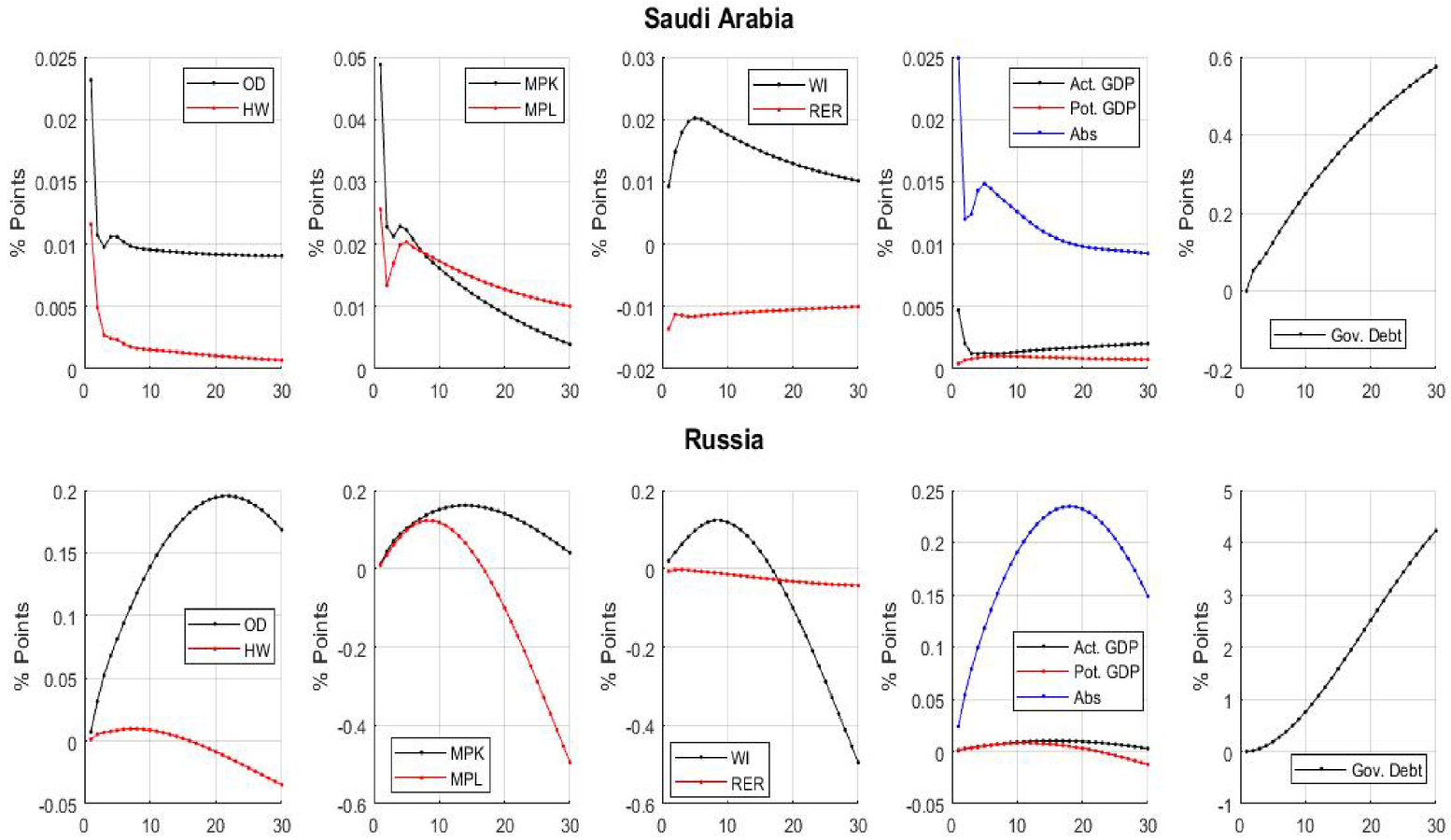
- Saudi has the most persistent I^g shock, perhaps due to high correlation between P^o and I^g, and large I^g share
- While $-\Delta I^g$ hurts Saudi Y initially, doesn't affect Russian Y—with both $+\Delta Y^p$ over MT
- Supply side channels dominate: $+\Delta MP^{kg}$



Oil intensity has benefits, but dangerous in LT

Shifts away from fossil fuels—does it hurt oil exporters?
Medium term gains, but Dutch disease and vulnerabilities build

- Foreign oil intensity shock—i.e., demand for oil in ROW falls, reducing global P^o
- Both Russia and Saudi are oil-intense in consumption and production, -so ΔP^o results in a domestic boom in oil and labor demand, along with $+\Delta MP^{L,K}$
- While $+\Delta Y$, $+\Delta Y^p$, only half of the $+\Delta$ absorption, i.e. large income windfall, with Dutch disease affects:
  - rer appreciates as pressure on relative NT/T from boom
  - $+\Delta Debt^{gov}$



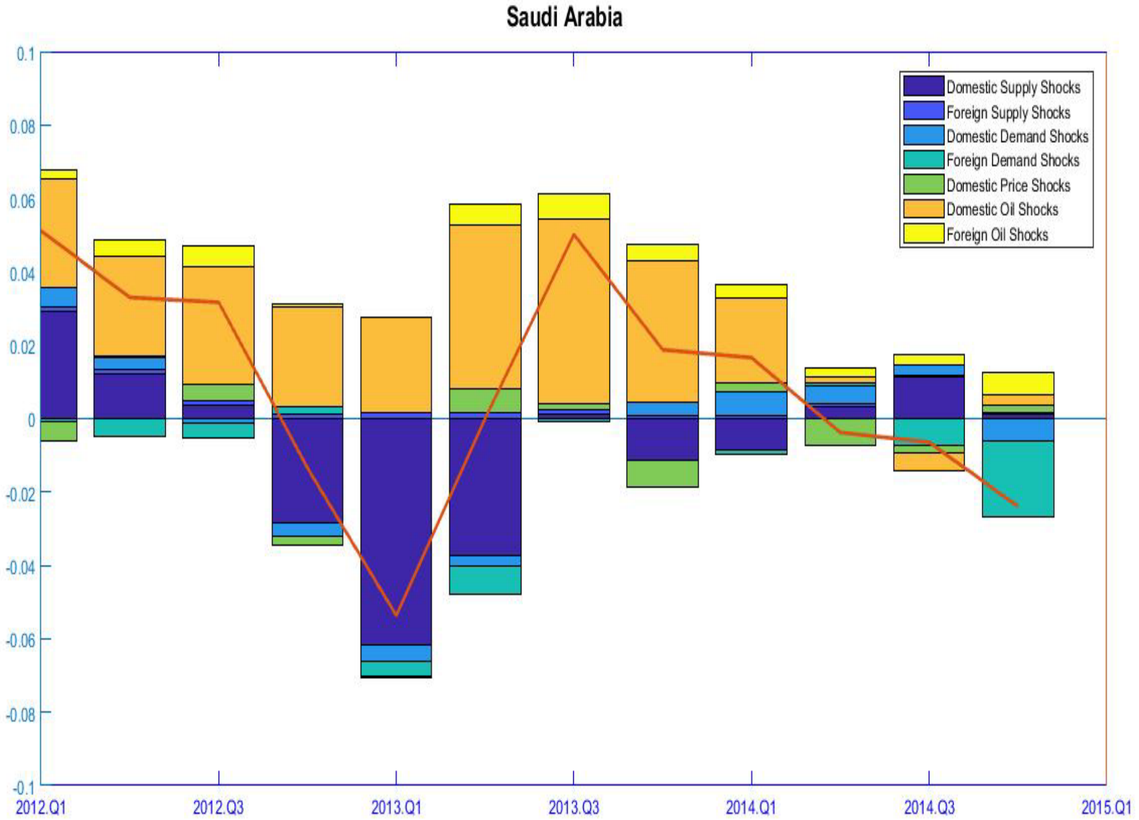
ESTIMATION—SHOCK DECOMPOSITIONS

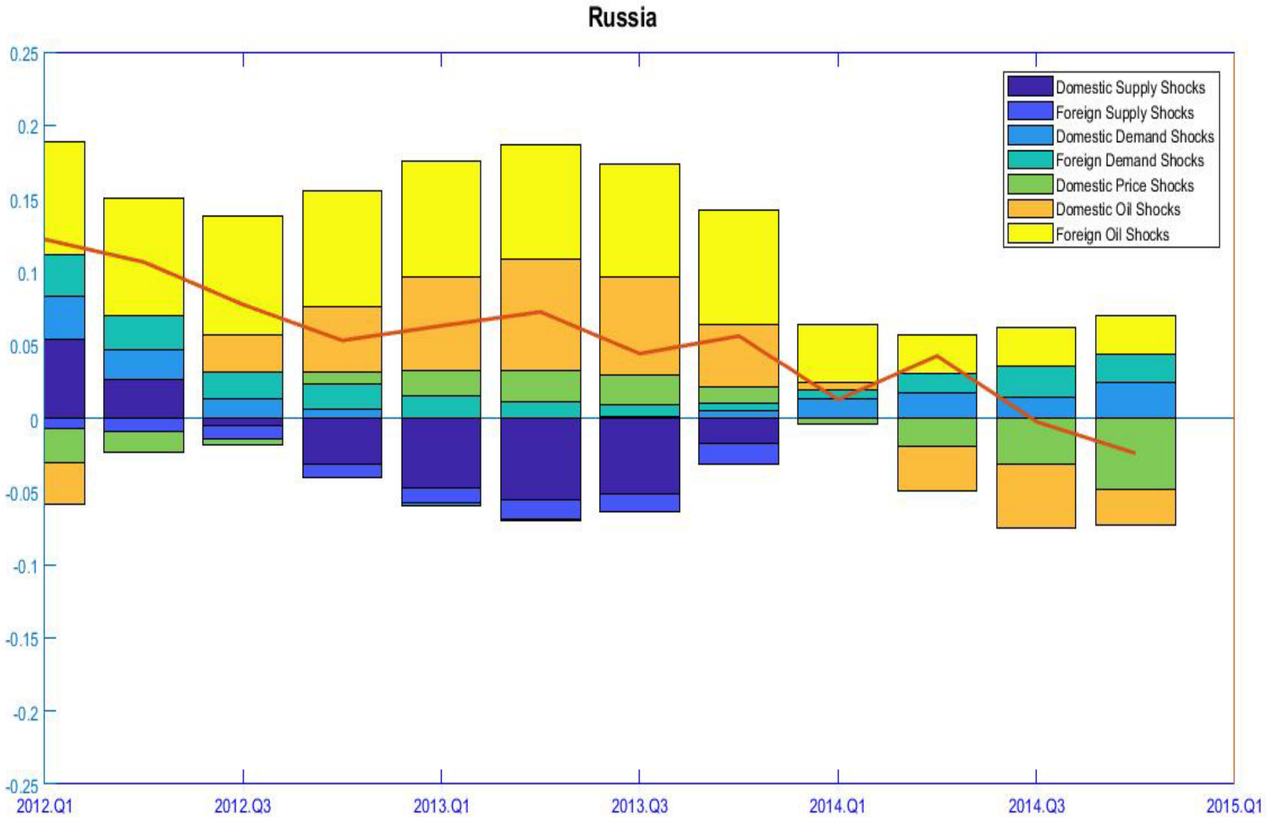
Diverging output volatility drivers during 2014

Historical decomposition of GDP growth's deviation from its mean

Saudi Arabian economy started contracting 2012Q4, led by a domestic productivity collapse, with oil demand and supply attenuating. These roles reversed in 2014Q3, and in 2014Q3&4 weak foreign demand pushed the economy back into recession.

Prior to oil price collapse and Crimean war of 2014, the Russian economy was slowing on weak domestic and foreign confidence (e.g., low FDI), with oil supply and demand attenuating. 2014Q1 onwards, sanctions and oil price collapse led to a depreciating REER, IT thus interest rates were hiked temporarily hurting the economy.





SCENARIO ANALYSIS

What works best?

	Improving productivity		*Moving away from fossil fuels*	
	No policy action	**Floating the exchange rate**	**No policy action**	**Tax rate reforms**
Russia	ΔY, -ΔRER, ΔNX, ΔINV Channels: temporary and small +ΔNon-oil prices and wages (no Balassa-Samuelson)	No difference	As before	Debt increase is marginal, while RER appreciation is very minor
Saudi Arabia	ΔY, ΔINV, -ΔRER, ΔNX, but non-oil exports take 5 years to respond—NO DIVERSIFICATION—plus persistent +Δnon-oil prices and wages (pressure on supply side); +Δinterest rate	Key difference: Non-oil exports pick up immediately, despite much larger REER volatility. Why? +ΔNon-oil prices and wage rise only a little and temporarily, but fall thereafter	As before	Debt increase is marginal, while RER appreciation is very minor

POLICY IMPLICATIONS AND CONCLUSIONS

Bottom Lines and Policy Implications

- We have shown how the diverse underlying economic structures of oil exporters play a role in fiscal consolidation:
  - Current spending-led fiscal consolidation *has temporary contractionary effects*, as in text books or in the UK economy. But unlike the UK, current spending-led fiscal consolidation has *positive and durable medium-term effects*, especially in Russia, including an improvement in competitiveness.
  - Capital spending-led fiscal consolidation has *no temporary contractionary effects* in Russia and Saudi Arabia, unlike the text book and UK. But it's *medium-term gains are smaller* than current spending led fiscal consolidation.
- When the global economy is doing well, a decline in oil intensity in the rest of the world (i.e., less oil used in consumption and production) surprisingly results in a semi-persistent domestic boom in these economies due to both supply and demand side factors and their own higher oil intensity. However, this boom results in Dutch disease and increasing vulnerabilities.
- To support medium-term growth, adjustment could target a more flexible exchange rate in Saudi Arabia if and only if there are reforms to support productivity gains.
- In the presence of foreign oil intensity shocks, i.e. a shift away from fossil fuels, tax reforms that shift the structure towards labor and fuel taxes, allows for a reduction in debt and less Dutch disease.

Questions?

Contact us:

sbeidasstrom@imf.org or m.lorusso@hw.ac.uk

Background

- **UK**. Post Brexit sterling depreciated, pushing up inflation, depressing private consumption, and business investment growth; growth moderated in 2017 despite significant monetary policy easing and strong trading partner growth; subdued in the near term; medium term growth depends on the extent of recovery of labor productivity
- **Russia**. Floated in Jan 2015 (stopped intervening and continued to hike interest rates); economy in 2017 stabilizing and coming out deep recession; but fiscal-state dominance and oil-dependency remain and structurally weak economy; suffered from Dutch disease in past; to lift growth diversify exports towards more complex and higher-value added products and services [and to sanction-free and faster growing trading partners]
- **Saudi Arabia**. Vision 2030 to diversify the economy; OPEC+ agreement to reduce oil supply & overall growth zero in 2017; but faster over MT due to structural reforms; 5% VAT introduced Jan 2018 but not enough to stem deficit/drain on NIR; reducing wage bill and administered utility prices would create room for pro-poor spending; removing obstacles to private sector led employment and growth. Exchange rate pegged.

And non-oil GDP Growth